Fisheries and Oceans Canada | Pêches et Océans Canada
Science | Sciences
Quebec Region
Canadian Science Advisory Secretariat
Science Advisory Report 2012/030

ASSESSMENT OF THE ESTUARY AND NORTHERN GULF OF ST. LAWRENCE (AREAS 13 TO 17, 12A, 12B, 12C AND 16A) SNOW CRAB STOCKS IN 2011

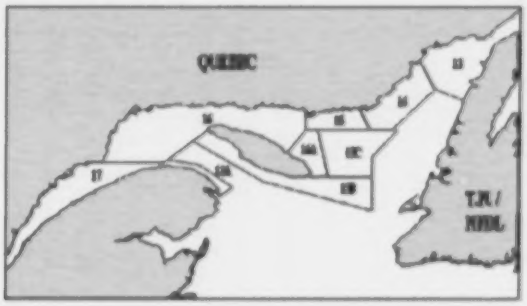


Figure 1: Snow crab management areas in the Estuary and the northern Gulf of St. Lawrence.

Context

The snow crab fishery in the Estuary and the northern Gulf of St. Lawrence began in the late 1960s. The fishery experienced a boom from 1979 to 1985, and a management approach based on the TAC (total allowable catch) was gradually introduced between 1985 and 1995. There are nine management areas (13 to 17, 16A, 12A, 12B and 12C) (Figure 1).

Landings have varied depending on the adjusted TACs based on the recruitment waves and troughs that have affected the fishery (Figure 2), with maximum levels recorded in 1995 (7,879 t) and 2002 (10,372 t). Landings dropped considerably in 2003 owing to the lower TACs established in response to signs of overfishing, mainly in Area 16. Landings totalled 7,490 t in 2011.

The fishery targets only males with a carapace width ≥ 95 mm. White crab (crab that has recently moulted) and adolescent males may be returned to the water during the fishing season to enhance their meat yield and give them a chance to reproduce. Furthermore, since 1985, when the proportion of white crab in catches at sea exceeds 20%, the fishery in the area concerned is automatically closed to minimize the mortality of these very fragile crabs that will be available to the fishery the following year.

The DFO Fisheries and Aquaculture Management Branch, Quebec Region, requested a resource status assessment as well as scientific advice in order to set the 2012 quotas. A scientific peer review was conducted on February 8 and 9, 2012. Participants included representatives from DFO Science and Fisheries and Aquaculture Management, the fishing industry, provincial governments and the First Nations.

SUMMARY

In 2011, most of the stocks in the northern Gulf of St. Lawrence had low or declining residual biomass and recruitment to the fishery increased (Areas 13, 14, 15, 16, 16A and 12C). This increase in recruits foreshadows a recruitment wave in this part of the Gulf of St. Lawrence. Although recruitment is not increasing, stocks further south (12A, 12B and 17) showed an increase in commercial biomass in response to moderate catches in recent years.

In areas 17 and 12A, the decrease in TAC from 2006 to 2008 stabilized the commercial biomass, which then continued to recover gradually until 2011. In area 12B, moderate fishing pressure from 2005 to 2009 appeared to help increase the commercial biomass somewhat. In areas 16, 15, 14, 12C and 16A, a decrease in residual biomass was partially offset by an increase in recruits, which helped maintain the commercial biomass. There was also a recruitment wave in area 13 but, until now, there is little evidence of it in the legal portion of fishing catches or surveys.

The purpose of the notices is to maintain an adequate male reproductive biomass in order not to adversely affect the recovery or maintenance of the population in a given area. Recommendations assume that the natural mortality rate will be the same in 2012 as in previous years.

Recommendations:

In Area 17, a TAC increase in the order of 10% in 2012 compared to 2011 should not result in an excessively high exploitation rate.

In Area 16, maintaining the 2012 catch at 2011 levels should reduce the exploitation rate and the fishery's reliance on recruitment.

In Area 12A, a 40% increase in the 2012 catch over 2011 levels should not lead to an excessively high exploitation rate.

In Area 12B, an increase in 2012 catches not exceeding those recorded in 2011 by more than 20% should not cause a significant decrease in commercial biomass.

In areas 15, 14, 12C and 16A, maintaining 2012 catches at 2011 levels should preserve the commercial biomass.

In Area 13, catches not exceeding 150 t in 2012 would help stabilize the commercial biomass, which has decreased slightly since 2009.

INTRODUCTION

Species biology

In Canada, snow crab can be found from the southern tip of Nova Scotia to halway up the Labrador coast, as well as in the Estuary and Gulf of St. Lawrence. In the Gulf of St. Lawrence, commercial-size males live at depths ranging from 60 to 220 m, except during their moulting and reproductive periods during which they migrate to shallower waters. Snow crab stop growing after their terminal moult. Males are considered adolescents (small claws) prior to the terminal moult and adults (large claws) afterward. Male carapace width (CW) ranges from 40 to 165 mm after the terminal moult. If they do not undergo their terminal moult earlier, males reach legal size (95 mm CW) at about nine years of age. Snow crab recruitment is periodic or episodic and varies considerably over an 8- to 12-year cycle. The entry of recruits into the fishery can be determined by regular monitoring of landings (carapace size and condition) and the catch rate (catch per unit effort, CPUE), and is confirmed by scientific trap and trawl surveys.

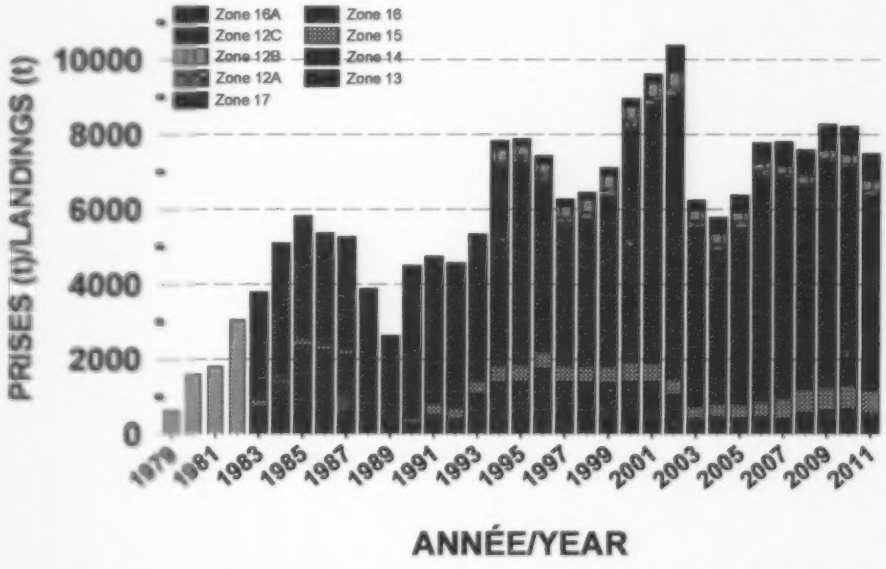


Figure 2. Snow crab landings in the Estuary and northern Gulf of St. Lawrence. From 1979 to 1982, landings were not differentiated by area.

ASSESSMENT OF THE RESOURCE

Analyses of all areas are based on fishing data from logbooks, processing plant purchase slips and dockside weighing summaries, along with catch sampling data obtained from the Observers Program and DFO samplers. In 2011, the industry conducted a trap-based research survey in all fishing areas and the findings were incorporated into the stock status analyses. These surveys help determine the mean NUE (numbers per unit effort) of commercial-size crab by area and the NUE of adolescent crab with carapaces over 78 mm wide that will reach or

remain at legal size during the following moult. The results of the trawl research surveys conducted in 2010 and 2011 in Areas 13 and 17 were used to calculate a juvenile or adult crab abundance index.

The fishery's raw catches per unit effort (CPUE) were standardized using an additive model to account for seasonal changes, gear type, soak time and fishing site. The proportion of new crabs or recruits, which can be identified by their new carapace (carapace conditions 1 and 2), was determined by dockside samplers.

Data on the size, structure of crab sampled at sea, dockside and during trap surveys were also used.

To date, data on female insemination levels have been collected sporadically in certain areas. Annual systematic sampling of each area is recommended so this parameter can be used for stock status assessments, because it is a measure of female mating success and the relative abundance of large adult males.

Area 17

Description of the fishery

There are 22 active licence holders in Area 17. The TAC dropped 44% between 2006 and 2008, remained unchanged in 2009 and 2010 and increased by 10% in 2011 to 1,573 t (Figure 3), including 189 t of temporary allocations. The fishing season began March 30, closed June 23 and the TAC was met.

Resource status in 2011

In the commercial fishery, the standardized CPUE remained high from 2000 to 2004 then dropped nearly 50% between 2004 and 2008 (Figure 4). It increased in 2009, near the series average and remained there in 2010 before rising again in 2011 to a value well above average. Landings were dominated by recruits (new crabs, carapace conditions 1 and 2) from 2007 to 2009 and then by intermediate-shell crab (condition 3) in 2010 and 2011 (Figure 5). Intermediate-shell crab accumulated during the last recruitment wave had largely supported the fishery between 1999 and 2006. The proportion of old crab (conditions 4 and 5) in landings has been low over the last few years The mean size of legal-size crab caught at sea was slightly above average from 2007 to 2010 then increased to 113 mm in 2011 (Figure 6).

Results of the postseason trawl survey, a data series that began in 1996 on the north shore and in 1999 on the south shore, showed that the NUE of adults ≥ 95 mm decreased by more than 50% from 2005 to 2007 and remained below average from 2007 to 2011 (Figure 7). The number of crabs left by the fishery, i.e. intermediate-shell or old crabs (conditions 3, 4 and 5) followed the same trend. The number of recruits (conditions 1 and 2) remained near the mean from 2005 to 2008, then reached very high levels in 2009 and 2010 (Figure 8), which contributed significantly to maintaining the available commercial biomass during the last two fishing seasons. In 2011 the number of recruits decreased to near average values. After reaching the highest value of the series in 2009, the number of adolescents ≥ 78 mm caught in traps decreased significantly in 2010 and 2011 to well below average (Figure 8). The mean size

of legal-size adult crab increased slightly during the 2011 post-season survey, suggesting that it will remain above average during the 2012 commercial catch.

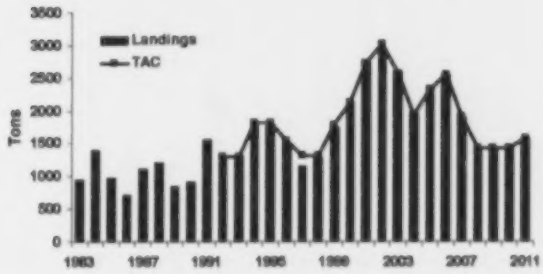


Figure 3. Landings and TAC in Area 17 from 1983 to 2011.

Figure 6. Mean carapace width ± confidence interval for commercial-size crabs sampled at sea from 1986 to 2011 in Area 17. The dotted line shows the data series mean.

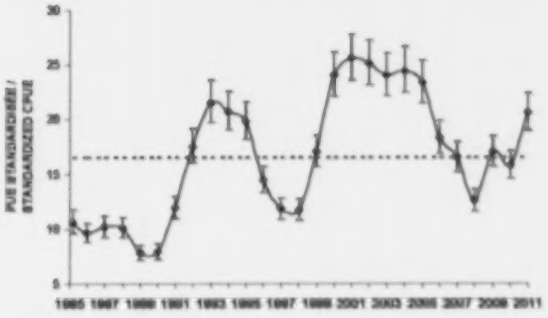


Figure 4. Standardized CPUE ± confidence interval in the commercial fishery from 1985 to 2011 in Area 17. The dotted line shows the data series mean.

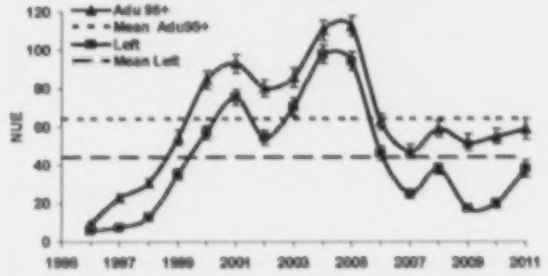


Figure 7. Catch rates (NUE), with confidence interval and mean, of adult crab ≥ 95 mm and those left by the post-season survey fishery in Area 17 from 1996 to 2011.

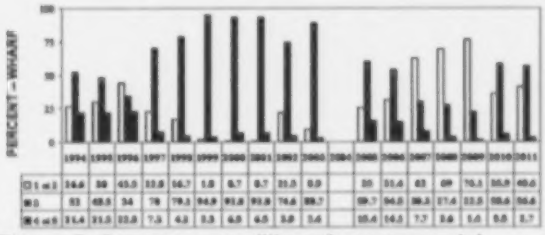


Figure 5. Carapace conditions for commercial crabs landed in Area 17 from 1994 to 2011.

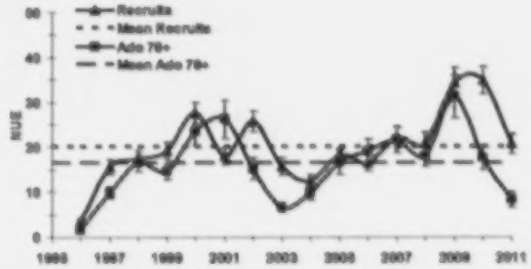


Figure 8. Catch rates (NUE), with confidence interval and mean, of adolescent crab ≥ 78 mm and recruits from the post-season survey in Area 17 from 1996 to 2011.

Results from the trawl survey conducted on the north shore of the Estuary indicated that the abundance of adolescents between 78 and 95 mm decreased slightly from 2009 (13.9 crabs/10,000 m^2) to 2011 (8.6 crabs/10,000 m^2) and was low, whereas the abundance of adolescents between 40 and 78 mm, which was low, increased from 20.5 crabs/10,000 m^2 to 192.6 crabs/10,000 m^2 during this period. The abundance of males ≤ 40 mm, which was very high in 2009, decreased but remained high in 2011 at 350.4 crabs/10,000 m^2.

In 2011, the average amount of sperm stored in the females' spermathecae decreased significantly, indicating a sex ratio imbalance favouring females.

Conclusion and advice

The TAC increased by 10% between 2010 and 2011 to 1,573 t, and was met.

The catch rate during the 2011 commercial fishery increased and was well above average for the first time since 2006. Landings consisted of intermediate-shell crabs and recruits.

The postseason survey suggested that 2012 fishing yields will be similar to those of 2011 and landings will include a lower percentage of recruits.

The size of the crabs caught in the commercial fishery increased in 2011 and was well above average. It should remain high in 2012 according to the post-season survey.

The postseason and trawl surveys indicated that the abundance of adolescents ≥ 78 mm dropped sharply in 2011 for a second year in a row. The trawl survey also revealed a high abundance of adolescents between 20 and 78 mm and females between 20 and 55 mm. The sex ratio among breeders favoured females, which was demonstrated by the spermathecae load which decreased in 2011.

The reduction of fishing pressure, following the 44% decrease in TAC from 2006 to 2008, enabled the commercial biomass to recover somewhat from 2009 to 2011. However, a decrease in the abundance of adolescents ≥ 78 mm in 2010 and 2011 followed by a decrease in recruits in 2011 suggested that fewer new crabs will enter the fishery in 2012 than in the last two years.

Recommendation

A TAC increase in the order of 10% in 2012 compared to 2011 should not result in an excessively high exploitation rate.

Area 16

Description of the fishery

In Area 16, there are 39 fishers who hold regular snow crab fishing licences in group A (92.7% of the TAC) and 20 in group B (7.3% of the TAC). After having peaked at 4,606 t in 2009 and 2010, the TAC decreased by 20% in 2011 to 3,686 t (Figure 9). In 2011, landings were 3,653 t

and the fishing season, scheduled from April 11 to July 17, was shortened slightly due to a strong presence of white crab (crab that had recently molted) in catches at sea.

Resource status in 2011

In the fishery, the standardized CPUE, which remained slightly above average in 2008 and 2009, dropped significantly in 2010 before increasing to average levels in 2011 (Figure 10). Landings since 2006 (Figure 11) were comprised primarily of recruits (carapace conditions 1 and 2) and very few old crabs (conditions 4 and 5) which was consistent with high fishing pressure. The mean size of legal-size crabs caught at sea, which started to rebound in 2003 after a period of sharp decline, dropped in 2009 and 2010 then increased again to 111.5 mm in 2011 (Figure 12).

Post-season trap surveys, conducted every fall since 1994, showed that the NUE of adults ≥ 95 mm increased in 2011 after having trended downward from 2007 to 2010 (Figure 13). The number of intermediate-shell or old crabs (conditions 3, 4 and 5) left by the fishery also dropped from 2007 to 2010 but increased slightly in 2011 (Figure 13). The number of recruits (conditions 1 or 2) had been above average since 2007, reaching the highest value of the series in 2011 (Figure 14). More biomass should therefore be available at the beginning of the 2012 season than in 2011. During the survey, the mean size of adult crab ≥ 95 mm was stable between 2010 and 2011, suggesting that it will vary little in commercial catches in 2012.

The mean NUE of adolescents ≥ 78 mm has been significantly above average since 2007 (Figure 14), which suggests good medium-term recruitment.

Results from the yearly trawl survey conducted in Sainte-Marguerite Bay near Sept-Îles revealed a recruitment wave consistent with post-season survey observations. This recruitment wave should help maintain the commercial biomass.

The spermathecae of females from Sainte-Marguerite Bay contained more sperm in 2011 than in 2010, indicating a greater relative availability of large males.

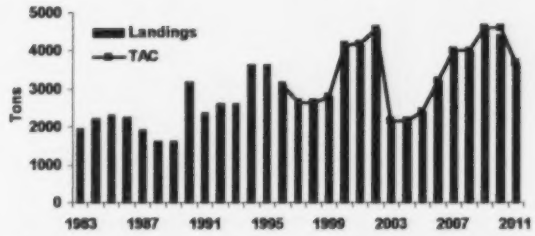


Figure 9. Landings and TAC in Area 16 from 1983 to 2011.

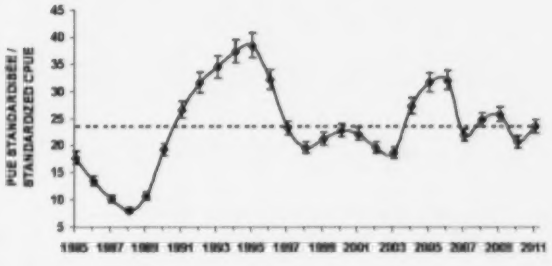


Figure 10. Standardized CPUE ± confidence interval in the commercial fishery from 1985 to 2011 in Area 16. The dotted line shows the data series mean.

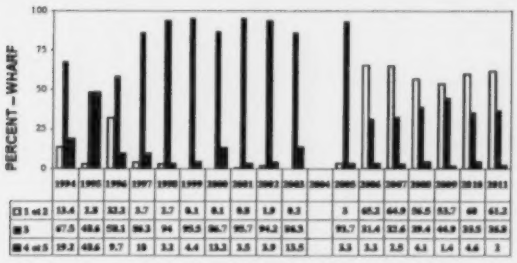


Figure 11. Carapace conditions for commercial crabs landed in Area 16 from 1994 to 2011.

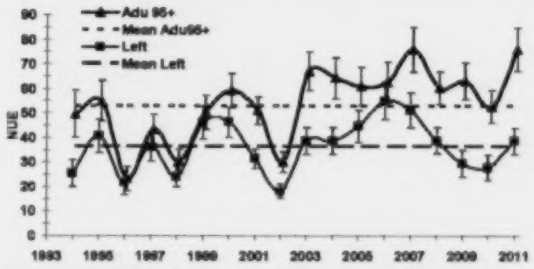


Figure 13. Catch rates (NUE), with confidence interval and mean, of adult crab ≥ 95 mm and those left by the post-season survey fishery in Area 16 from 1994 to 2011.

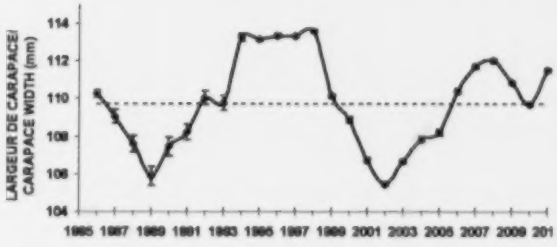


Figure 12. Mean carapace width ± confidence interval for commercial-size crabs sampled at sea from 1986 to 2011 in Area 16. The dotted line shows the data series mean.

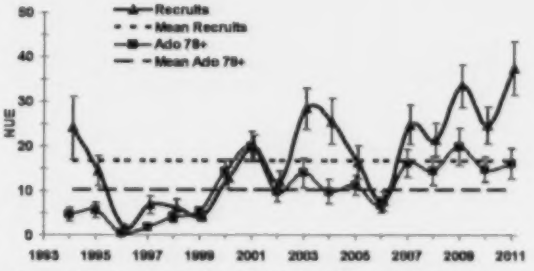


Figure 14. Catch rates (NUE), with confidence interval and mean, of adolescent crab ≥ 78 mm and recruits from the postseason survey in Area 16 from 1994 to 2011.

Conclusion and advice

The TAC decreased by 20% to 3,686 t between 2010 and 2011, and landings were 3,653 t. The area was closed late in the season because of a high percentage of white crab in the catches.

The catch rate increased during the 2011 commercial fishery. It had been near average since 2007. Landings had consisted primarily of recruits since 2006.

The postseason survey suggested that fishing yields would be higher in 2012 and that landings would still be primarily comprised of recruits.

The size of crabs caught in the commercial fishery increased in 2011 and was well above average. It should remain at similar levels in 2012 according to the post-season survey.

The abundance index of adolescents ≥ 78 mm from the post-season survey has been above average since 2007. The trawl survey conducted in the western part of the area indicated that fishing was driven by a new recruitment wave and suggested that the exploitation rate was significantly higher than average since 2006.

The 20% decrease in TAC in 2011 helped the commercial biomass to recover somewhat. Moderate fishing pressure in 2012 would help build the intermediate-shell crab population, make fishing yields less dependent on recruitment and reduce the rate of exploitation, which currently seems high.

Recommendation

Maintaining the 2012 catch at 2011 levels should reduce the exploitation rate and the fishery's reliance on recruitment.

Area 15

Description of the fishery

Area 15 has 8 regular fishers. Since 2008, the TAC has peaked at 593 t (Figure 15), including 55 t in temporary allocations. In 2011, the fishery opened April 11 and closed July 17. The TAC has always been met.

Resource status in 2011

The standardized CPUE from the commercial fishery was well above average from 2006 to 2010 and then decreased to average levels in 2011 (Figure 16). Fishing effort was concentrated in the western section. In 2010 and 2011, landings consisted primarily of intermediate-shell crabs (condition 3) whereas recruits (conditions 1 and 2) accounted for just over a quarter of the crabs examined while the percentage of old crabs (conditions 4 and 5) remained stable (Figure 17). Although the mean size of legal-size crabs caught at sea decreased slightly since 2009, it remained well above the 110.3 mm average in 2011 (Figure 18).

The **scientific trap survey**, which has been conducted since 1998, showed that the NUE of adults ≥ 95 mm was high from 2005 to 2009, then dropped below average in 2010 before rebounding to above average values in 2011 (Figure 19). The abundance of intermediate-shell or old crabs (conditions 3, 4 and 5), which are left by the fishery, is strongly correlated with that of all commercial-size crab, and remained stable and below average in 2011 (Figure 19). The increase in NUE of all legal crabs was related to a sharp increase in recruits (conditions 1 and 2) in 2011 which was the highest value of the series (Figure 20) and accounted for almost 50% of the postseason survey catch. Thus, the post-season survey results suggested that more biomass could be available at the beginning of the 2012 season than in 2011. The mean size of adult crab ≥ 95 mm fell from 2010 to 2011 suggesting that it will be smaller in commercial catches in 2012. The NUE of adolescents ≥ 78 mm increased dramatically in 2011 and was also at a historic high, suggesting high recruitment to the fishery in the short-term (Figure 20).

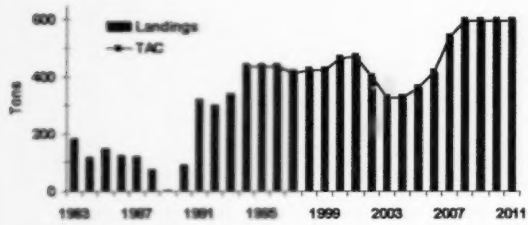


Figure 15. Landings and TAC in Area 15 from 1983 to 2011.

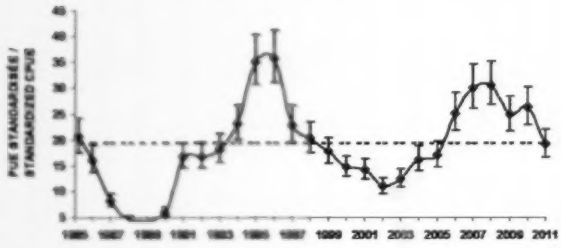
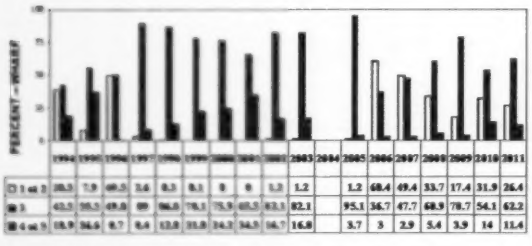


Figure 16. Standardized CPUE ± confidence interval in the commercial fishery from 1985 to 2011 in Area 15. The dotted line shows the data series mean.



	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1 et 2	28.3	7.9	49.5	3.6	0.3	0.1	0	0	1.3	1.2		1.2	68.4	49.4	33.7	17.4	31.9	26.4
3	43.5	55.3	41.0	89	86.0	78.1	75.9	65.5	82.1	82.1		95.1	36.7	47.7	65.9	78.7	54.1	62.2
4 et 5	28.9	36.6	9.7	8.4	13.8	21.8	24.2	34.5	16.7	16.8		3.7	5	2.9	5.4	3.9	14	11.4

Figure 17. Carapace conditions for commercial crabs landed in Area 15 from 1994 to 2011.

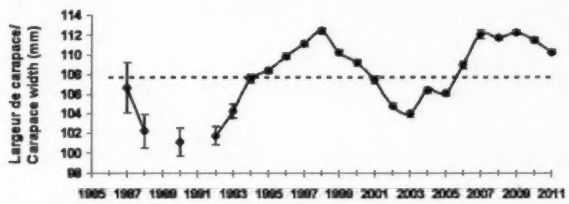


Figure 18. Mean carapace width ± confidence interval for commercial-size crabs sampled at sea from 1987 to 2011 in Area 15. The dotted line shows the data series mean.

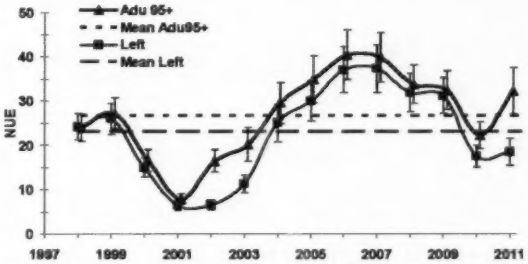


Figure 19. Catch rates (NUE), with confidence interval and mean, of adult crab ≥ 95 mm and those left by the post-season survey fishery in Area 15 from 1998 to 2011.

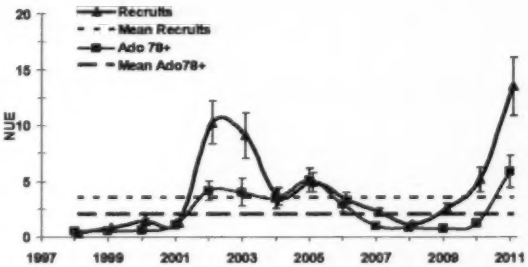


Figure 20. Catch rates (NUE), with confidence interval and mean, of adolescent crab ≥ 78 mm and recruits from the post-season survey in Area 15 from 1998 to 2011.

Conclusion and advice

The TAC and landings have peaked at 593 t since 2008.

The commercial fishery catch rate decreased to near average values in 2011. Landings consisted primarily of intermediate-shell crabs. The easternmost area remains largely unexploited.

The post-season survey suggested that fishing yields will be higher in 2012 and include a greater percentage of recruits.

The size of crabs caught in the commercial fishery decreased in 2010 and 2011, but remained well above average. It could decrease further in 2012 according to the post-season survey.

The abundance index of adolescents ≥ 78 mm in the post-season survey was significantly higher than during the previous four years, foreshadowing increased recruitment in the short term.

It would be advisable not to increase the TAC until the commercial biomass indicators reflect the expected impact of recruitment.

Recommendation

Maintaining 2012 catches at 2011 levels should preserve the commercial biomass.

Area 14

Description of the fishery

Area 14 has 21 regular fishers. The TAC decreased by 20% between 2010 and 2011 to 407 t (Figure 21). In 2011, the fishing season opened May 1 and closed August 6. The TAC was met.

Resource status in 2011

The standardized CPUE from the commercial fishery surged to a high value from 2007 to 2009, then dropped sharply to a value significantly below average in 2010, which remained stable in 2011 following a decrease in the TAC (Figure 22). Intermediate-shell crabs (condition 3) have clearly dominated landings since 2008 although the percentage of recruits (conditions 1 and 2) increased during this period (Figure 23). The mean size of legal-size crabs caught at sea has decreased since 2008 and was slightly below average at 105.9 mm in 2011 (Figure 24).

The **scientific trap survey**, which has been conducted since 1996, showed that the NUE of adults ≥ 95 mm decreased from 2008 to 2010 and then increased slightly in 2011, but to a value still well below average, as did the abundance of intermediate-shell and old crabs (conditions 3, 4 or 5) with which it is strongly correlated (Figure 25). Recruits (conditions 1 and 2) were below average from 2004 to 2009 before increasing sharply to above average levels in 2010 and 2011 (Figure 26). Thus, post-season survey results suggested that the biomass

available at the beginning of the 2012 season will still be low. The mean size of adult legal-size crabs has followed a slight downward trend since 2008, suggesting that the size of legal crabs caught in the commercial fishery will vary little in 2012 compared to 2011. The NUE of adolescents ≥ 78 mm rose from a value slightly below average in 2010 to a well above average record value in 2011, foreshadowing increased recruitment to the fishery in the short term (Figure 26).

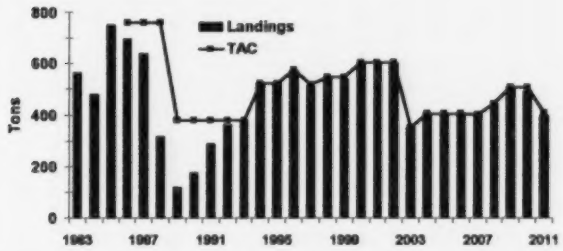


Figure 21. Landings and TAC in Area 14 from 1983 to 2011.

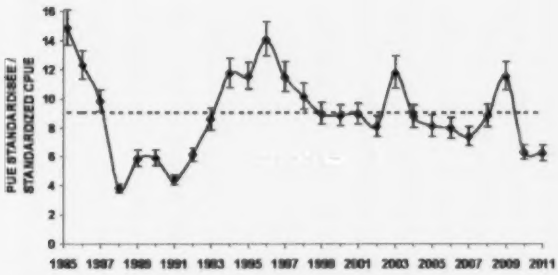


Figure 22. Standardized CPUE ± confidence interval in the commercial fishery from 1985 to 2011 in Area 14. The dotted line shows the data series mean.

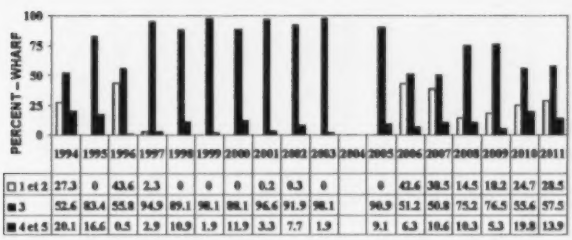


Figure 23. Carapace conditions for commercial crabs landed in Area 14 from 1994 to 2011.

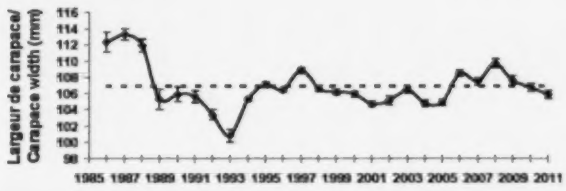


Figure 24. Mean carapace width ± confidence inter commercial-size crabs sampled at sea from 1986 to 2 Area 14. The dotted line shows the data series mean.

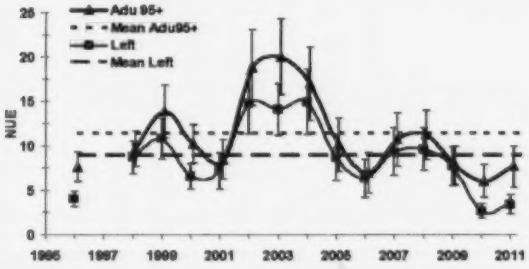


Figure 25. Catch rates (NUE), with confidence interval and mean, of adult crab ≥ 95 mm and those left by the post-season survey fishery in Area 14 from 1996 to 2011.

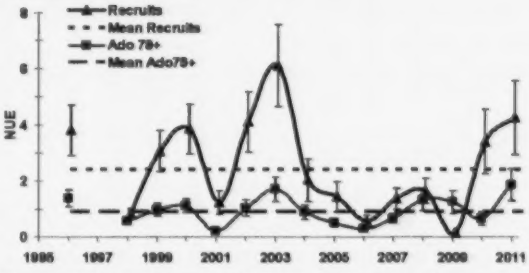


Figure 26. Catch rates (NUE), with confidence interval and mean, of adolescent crab ≥ 78 mm and recruits from the postseason survey in Area 14 from 1996 to 2011.

Conclusion and advice

The 2011 TAC decreased 20% from 2010 to 407 t and was met.

The commercial fishery catch rate was stable but below average in 2010 and 2011. Landings consisted primarily of intermediate-shell crabs although the percentage of recruits had been increasing since 2009.

The post-season survey suggested that fishing yields in 2012 will remain below average and include a significant percentage of recruits.

The size of crabs caught in the commercial fishery decreased slightly for the third year in a row and was below average in 2011. It should not change in 2012 according to the post-season survey.

The post-season survey indicated an increase in the abundance of adolescent crab ≥ 78 mm in 2011, the highest level of the series.

According to the various indices, commercial biomass remained low. It would be advisable not to increase the TAC until there is evidence that the commercial biomass has recovered somewhat. Decreasing the TAC would help the biomass recover in the shorter term.

Recommendation

Maintaining 2012 catches at 2011 levels would preserve the commercial biomass.

Area 13

Description of the fishery

There are 43 fishers from Quebec in Area 13 and 6 from Newfoundland. The area was placed under a moratorium from 2003 to 2007 as a result of a sharp drop in biomass. However, an index fishery with an annual 50-t TAC was approved in 2003, 2004 and 2006. The area was reopened to the commercial fishery in 2008 with a 150-t TAC for 2008 and 2009. TACs were then set at 188 t for 2010 and 2011 (Figure 27). Landings totalled 154 t in 2011. The fishing season opened May 1 and closed August 6.

Resource status in 2011

The standardized CPUE from the commercial fishery had been on a slight downward trend since 2008 but in 2011 was at a value similar to the 1988–2010 average (Figure 28). The area harvested since 2008 was relatively small compared to the total areas traditionally harvested and in 2011 the fishing effort was highest in the south. Since 2008, intermediate-shell crabs (condition 3) accounted for most of the landings (Figure 29). In 2011, the percentage of recruits (conditions 1 and 2) increased compared to 2010, while the percentage of old crabs (conditions 4 and 5) decreased. The mean size of legal-size crabs caught at sea in 2011 (104.6 mm) was slightly higher than the average of the historical series (Figure 30), but remained low compared to that in other areas of the northern Gulf of St. Lawrence.

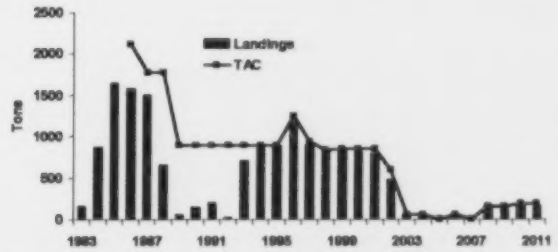


Figure 27. Landings and TAC in Area 13 from 1983 to 2011.

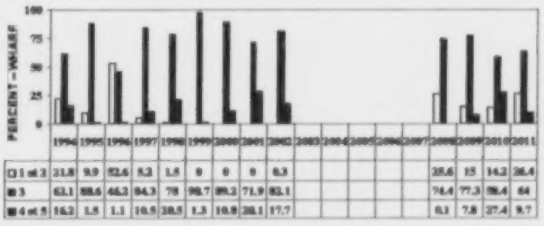


Figure 29. Carapace conditions for legal-size crabs landed in Area 13 from 1994 to 2011.

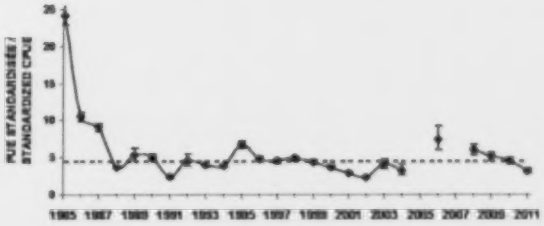


Figure 28. Standardized CPUE ± confidence interval in the commercial fishery from 1985 to 2011 in Area 13. The dotted line shows the average data from 1988 to 2010.

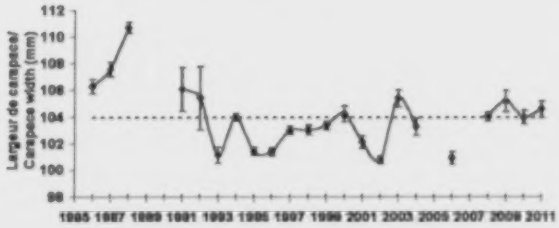


Figure 30. Mean carapace width ± confidence interval for commercial-size crabs sampled at sea from 1986 to 2011 in Area 13. The dotted line shows the data series mean.

The **scientific trap surveys** conducted since 1999 showed that the NUE of adults ≥ 95 mm was low and stable from 2001 to 2007 in the north, then increased in 2008 and 2009, reaching values well above the historic series average, before dropping sharply below average in 2011 (Figure 31). For the south, the survey indicated that the NUE of adults ≥ 95 mm was low from 2001 to 2005, high from 2006 to 2010, before falling to below average in 2011 (Figure 32). The north and south surveys indicated that intermediate-shell or old crabs (conditions 3, 4 and 5) were the most abundant in the catches, although the number of recruits had been increasing in the north from 2006 to 2011 (Figure 33). In the south, recruits were abundant from 2004 to 2007, but abundance has been low since 2008 (Figure 34). Post-season survey results suggest that biomass available at the start of the 2012 season could decrease from 2011 levels and be comprised of a high percentage of intermediate-shell or old crabs. In post-season surveys, the mean size of adult crab has changed little since 2004 in the north, while in the south it increased slightly in 2011, which could foreshadow a slight increase in the size of crabs in 2012 commercial catches. The NUE of adolescent crab ≥ 78 mm in the north was high in 2008 and 2009, but dropped sharply in 2010, and despite an increase in 2011, remained below average (Figure 33). In the south, it decreased slightly in 2011 and has remained low since 2006 (Figure 34). Note that no adolescent crabs ≥ 95 mm were observed in the north during post-season surveys from 2004 to 2010.

Primiparous female insemination levels reflected a marked increase in mating success in 2011 compared to 2010, suggesting a greater availability of adult males.

The last **trawl survey** covering the northern part of Area 13 took place in 2010 and revealed a high abundance of adult crab less than 95 mm with some reproductive potential, despite their small size. The abundance of adolescent crab between 78 and 95 mm (4.1 crabs/10,000 m^2) was low. The abundance of adolescents between 62 and 78 mm has increased since 2008 to 44 crabs/10,000 m^2 in 2010. The abundance of adolescents between 40 and 62 mm increased considerably between 2004 and 2008, then decreased in 2010. Crabs less than 40 mm decreased significantly from a reported maximum of 800 crabs/10,000 m^2 in 2006, to 207.5 crabs/10,000 m^2 in 2008 and 47 crabs/10,000 m^2 in 2010.

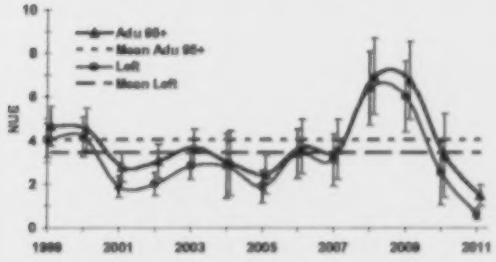


Figure 31. Catch rates (NUE), with confidence interval and mean, of adult crab ≥ 95 mm and those left by the post-season survey fishery in Area 13 North from 1999 to 2011.

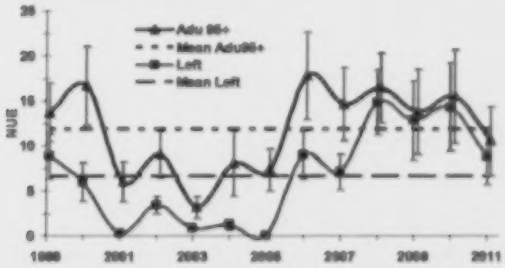


Figure 32. Catch rates (NUE), with confidence interval and mean, of adult crab ≥ 95 mm and those left by the post-season survey fishery in Area 13 South from 1999 to 2011.

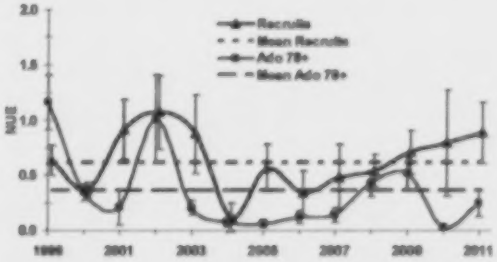


Figure 33. Catch rates (NUE), with confidence interval and mean, of adolescent crab ≥ 78 mm and recruits from the post-season survey in Area 13 North from 1999 to 2011.

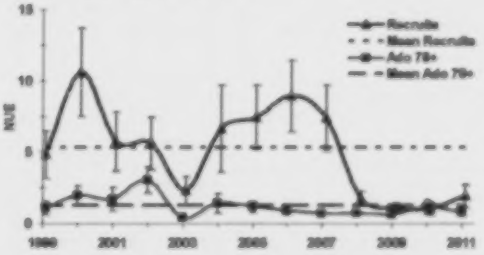


Figure 34. Catch rates (NUE), with confidence interval and mean, of adolescent crab ≥ 78 mm and recruits from the post-season survey in Area 13 South from 1999 to 2011.

Conclusion and advice

Following a five-year moratorium (2003 to 2007), the area was opened with a 150-t TAC for 2008 and 2009. The TAC was increased to 188 t for 2010 and 2011. Landings were 154 t in 2011.

The TAC for the commercial fishery had been on a slight downward trend since 2009 and in 2011 was a little below the 1988–2010 average. Fishing effort and yields were higher in the south. Since 2008, landings consisted largely of intermediate-shell crabs.

North and south post-season surveys suggest fishery yields will be lower in 2012 than in 2011. If the fishing effort remains higher in the south, landings will still primarily consist of intermediate-shell crabs, although there will be a greater percentage of recruits than in 2011.

The size of crabs caught in the commercial fishery was slightly above average in 2011 and, according to post-season surveys, could increase slightly in 2012.

In the north, the 2011 post-season survey and the 2010 trawl survey confirmed that adults under 95 mm were more abundant than commercial-size adults.

Post-season surveys indicate an increase in the abundance of adolescent crab ≥ 78 mm in the north and a slight decrease in the south. Values were slightly below average in both cases.

Although low, the TAC should not be increased until there is evidence that the commercial biomass has recovered somewhat.

Recommendation

Catches not exceeding 150 t in 2012 would help stabilize the commercial biomass, which has decreased slightly since 2009.

Area 12A

Description of the fishery

Area 12A has 10 regular licences. The TAC dropped from 229 t in 2006 to 80 t in 2008 as a result of an overall decrease in commercial biomass abundance indices, and when the stock rebounded, it gradually increased to 116 t in 2011 (Figure 35). In 2011, the fishing season opened on March 23, closed on May 31 and the TAC was met.

Resource status in 2011

In the commercial fishery, the standardized CPUE was relatively high from 1999 to 2005, then dropped sharply between 2005 and 2007 before starting to trend upwards, with a particularly sharp increase from 2010 to 2011 to the highest value in the series (Figure 36). Landings since 2005 have primarily been comprised of intermediate-shell crabs (condition 3), while recruits (conditions 1 and 2) have accounted for more than 20% of crabs since 2007 (Figure 37). Above average since 2008, the mean size of legal-size crabs caught at sea increased sharply from 2010 to 2011 to the highest value in the series (112.1 mm) (Figure 38).

The **scientific trap survey**, which has been conducted since 2000, shows that the NUE of adults ≥ 95 mm was below average from 2006 to 2009, increased in 2010, and in 2011 reached the highest value in the series, as did the number of intermediate-shell or old crabs (conditions 3 to 5), with which it is strongly correlated (Figure 39).

The NUE of recruits had been above average since 2010, after being low in 2008 and 2009 (Figure 40). Post-season survey results suggest that the biomass available at the beginning of the 2012 season could be higher than in 2011 and would be primarily comprised of

intermediate-shell crabs. The 2011 post-season survey shows the mean size of legal-size adult males has increased when compared with 2010, suggesting that the size of crabs will remain at high levels for the 2012 fishing season. The NUE of adolescents ≥ 78 mm has been near or above the historical average since 2006 (Figure 40).

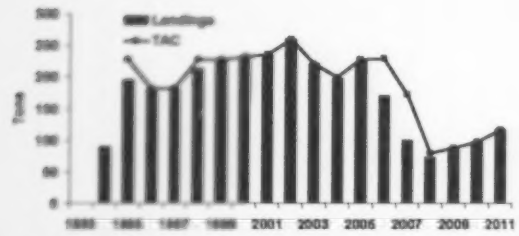


Figure 35. Landings and TAC in Area 12A from 1994 to 2011.

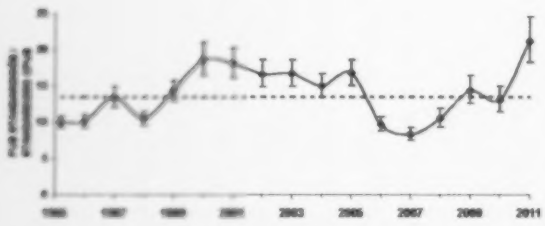
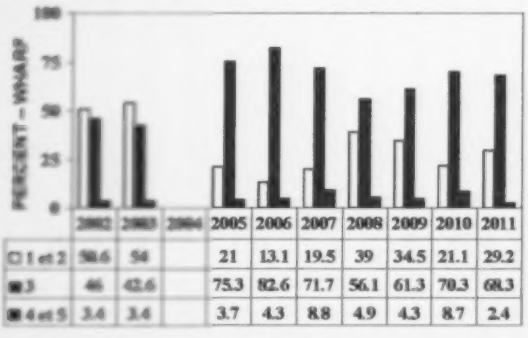


Figure 36. Standardized CPUE ± confidence interval in the commercial fishery from 1995 to 2011 in Area 12A. The dotted line shows the data series mean.



	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1 et 2	50.6	50		21	13.1	19.5	39	34.5	21.1	29.2
3	46	42.6		75.3	82.6	71.7	56.1	61.3	70.3	68.3
4 et 5	3.4	3.4		3.7	4.3	8.8	4.9	4.3	8.7	2.4

Figure 37. Carapace conditions for commercial crabs landed in Area 12A from 2002 to 2011.

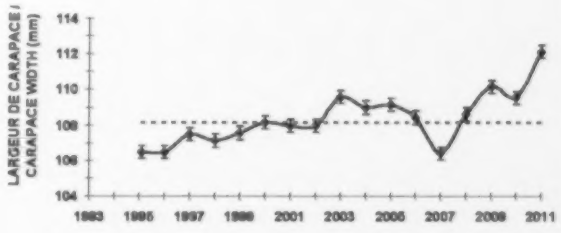


Figure 38. Mean carapace width ± confidence interval for commercial-size crab sampled at sea from 1995 to 2011 in Area 12A. The dotted line shows the data series mean.

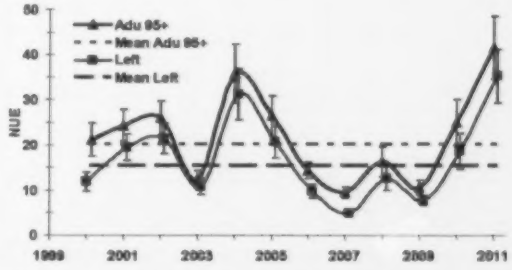


Figure 39. Catch rates (NUE), with confidence interval and mean, of adult crab ≥ 95 mm and those left by the post-season survey fishery in Area 12A from 2000 to 2011.

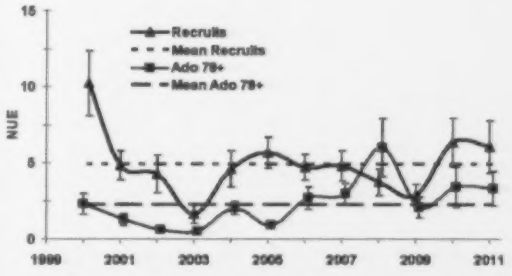


Figure 40. Catch rates (NUE), with confidence interval and mean, of adolescent crab ≥ 78 mm and recruits from the post-season survey in Area 12A from 2000 to 2011.

Note that the abundance of crabs in Area 12A is partially determined by overflow from adjacent areas (17 to the west and 12 to the east) which also experienced a sharp drop in commercial biomass after 2005, which has recovered somewhat recently.

Conclusion and advice

The TAC increased by 20% between 2010 and 2011 to 116 t, and was met.

The catch rate during the commercial fishery increased sharply in 2011, reaching the highest value of the series. Landings consisted primarily of intermediate-shell crabs.

The abundance index of crabs ≥ 95 mm in the post-season survey also reached a historic peak. Yields for 2012 should remain high and will consist primarily of intermediate-shell crabs.

The size of crabs caught in the commercial fishery in 2011 increased, reaching the highest value of the series; based on to the post-season survey, they will remain high in 2012.

The post-season survey indicated that the abundance of adolescent crab ≥ 78 mm was above average in 2010 and 2011.

The decrease in catches between 2005 (223 t) and 2008 (73 t) and good recruitment in 2010 and 2011 helped increase commercial biomass. The very high 2011 commercial fishing and post-season survey yields, and the fact that landings and the survey catch consisted primarily of intermediate-shell crabs, suggest that the stock may experience greater fishing pressure in 2012.

Recommendation

A 40% TAC increase in 2012 compared to 2011 should not result in an excessively high exploitation rate.

Area 12B

Description of the fishery

In 2010, there were 8 commercial fishing licenses for Area 12B. The TAC increased from 246 t in 2010 to 271 t in 2011 (Figure 41) and was met. In 2011, the fishery opened March 25 and closed June 24.

Resource status in 2011

The standardized CPUE from the commercial fishery was below average from 2003 to 2009 then increased sharply in 2010. It remained stable in 2011, its highest value since 2002 (Figure 42). Compared to previous years, there was a shift in fishing effort from east to west in 2010, which was maintained in 2011. Landings since 2005 have consisted primarily of intermediate-shell crabs (condition 3). The percentage of recruits (conditions 1 and 2) reached nearly 42% in 2011 (Figure 43). The mean size of legal-size crab caught at sea (Figure 44) was low from 2006 to 2009 then increased in 2010 and 2011, reaching 109.1 mm.

Figure 41. Landings and TAC in Area 12B from 1994 to 2011.

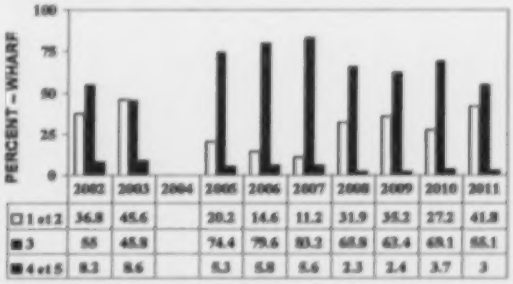


Figure 43. Carapace conditions for commercial crabs landed in Area 12B from 2002 to 2011.

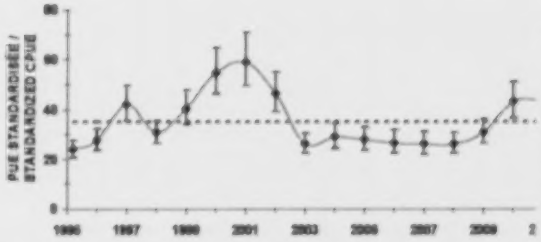


Figure 42. Standardized CPUE ± confidence interval in the commercial fishery from 1995 to 2011 in Area 12B. The dotted line shows the data series mean.

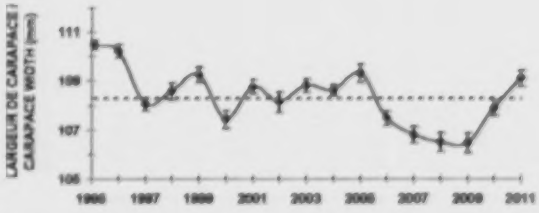


Figure 44. Mean carapace width ± confidence interval for commercial-size crab sampled at sea from 1995 to 2011 in Area 12B. The dotted line shows the data series mean.

The scientific trap survey, which has been conducted since 2001 (except for 2005), showed a sharp drop in the mean NUE of adults ≥ 95 mm from 2001 to 2003, which remained below the series average until 2010 before increasing in 2011 to a value well above average (Figure 45). The number of intermediate-shell or old crabs caught (conditions 3 to 5) followed the same trend, with a significant increase in 2011. The number of recruits (conditions 1 and 2) was above average from 2007 to 2010, then decreased to slightly below average in 2011 (Figure 46). The biomass available at the beginning of the 2012 season may therefore increase above 2011 levels, and could likely consist primarily of intermediate-shell crabs, with a lower percentage of recruits than in 2011. The mean size of legal-size adult crab was greater in the 2011 post-season survey than in the 2010 survey, which suggests that crab size will be greater in the 2012 season. The NUE of adolescents ≥ 78 mm, which was high in 2008, fell in 2009 and remained near the series average until 2011 (Figure 46).

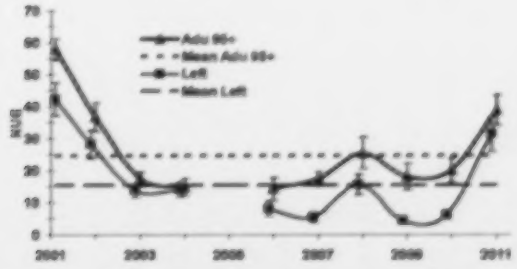


Figure 45. Catch rates (NUE), with confidence interval and mean, of adult crab ≥ 95 mm and those left by the post-season survey fishery in Area 12B from 2001 to 2011 (except for 2005).

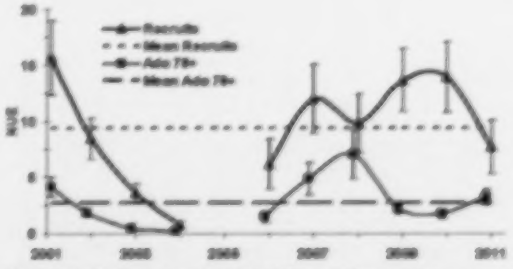


Figure 46. Catch rates (NUE), with confidence interval and mean, of adolescent crab ≥ 78 mm and recruits from the post-season survey in Area 12B from 2001 to 2011 (except for 2005).

Conclusion and advice

The TAC increased 10% between 2010 and 2011 to 271 t, and was met.

The catch rate in the commercial fishery was stable and above average between 2010 and 2011. Landings consisted of a slight majority of intermediate-shell crab.

The post-season survey suggested that the commercial fishery catch rate will be higher in 2012 than in 2011. Landings should consist primarily of intermediate-shell or old crabs, if the entire area is harvested.

The size of crabs caught in the commercial fishery has increased considerably since 2009 and, in 2011, was above average. According to the post-season survey it should remain high for 2012.

The 2011 post-season survey indicated that recruitment and abundance of adolescents ≥ 78 mm were near the historical average.

The stability of the commercial fishery catch rate, which was at a relatively high level, and the high abundance index of intermediate-shell or old crabs in the post-season survey suggest that a slight increase in catches would not cause excessive fishing pressure on the stock.

Recommendation

An increase in 2012 catches not exceeding those recorded in 2011 by more than 20% should not cause a significant decrease in commercial biomass.

Area 12C

Description of the fishery

Area 12C includes two banks (north and south sectors) separated by the deep channel of the Jacques-Cartier Strait. Five regular fishers operate in the area. The TAC has been set at a

maximum of 320 t since 2008 (Figure 47) including temporary 100-t allocations granted in 2011. The fishery opened April 11 and closed July 17.

Resource status in 2011

The standardized CPUE from the commercial fishery plummeted between 1996 and 1997 and remained below average until 2011 (except from 2006 to 2008) (Figure 48). Since 2006, fishing effort has been more concentrated in the northern section of the area than in previous years. Since 2008, landings have been comprised primarily of intermediate-shell crabs (condition 3) (Figure 49). Recruits (conditions 1 and 2) accounted for just over a quarter of crabs landed in 2011. The mean size of legal-size crabs caught at sea gradually increased from 2002 to 2008 then decreased in 2009 and 2010, but remained above average, before increasing slightly in 2011 to 111.6 mm (Figure 50).

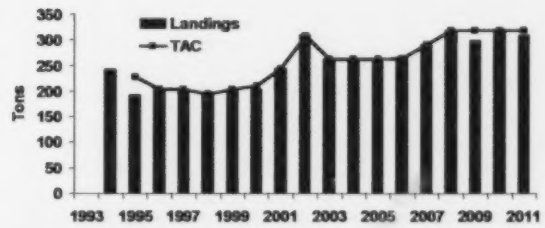
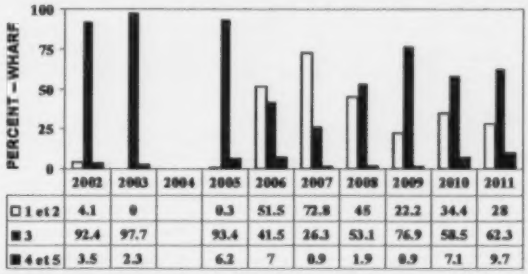


Figure 47. Landings and TAC in Area 12C from 1994 to 2011.



	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
□ 1 et 2	4.1	0		0.3	51.5	72.8	45	22.2	34.4	28
■ 3	92.4	97.7		93.4	41.5	26.3	53.1	76.9	58.5	62.3
■ 4 et 5	3.5	2.3		6.2	7	0.9	1.9	0.9	7.1	9.7

Figure 49. Carapace conditions for commercial crabs landed in Area 12C from 2002 to 2011.

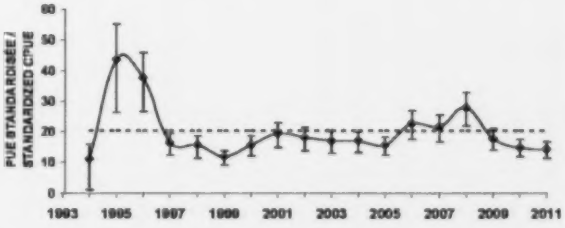


Figure 48. Standardized CPUE ± confidence interval in the commercial fishery from 1994 to 2011 in Area 12C. The dotted line shows the data series mean.

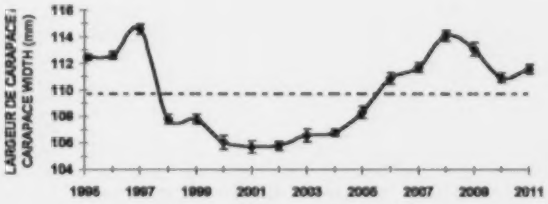


Figure 50. Mean carapace width ± confidence interval for commercial-size crab sampled at sea from 1995 to 2011 in Area 12C. The dotted line shows the data series mean.

The scientific trap survey conducted since 2000 shows that the NUE of adults ≥ 95 mm has been stable and near average since 2007, but the number of intermediate-shell or old crabs (conditions 3 to 5) in the catches has decreased since 2008, reaching the lowest value of the series in 2011 (Figure 51). Conversely, the number of recruits (conditions 1 and 2) has increased since 2009, reaching the highest value of the series in 2011 (Figure 52). Post-season survey results suggest that the biomass available at the beginning of the 2012 fishery will be comparable to 2011 levels and would comprise a greater percentage of recruits even if intermediate-shell crabs still account for the majority. The mean size of legal-size adult crab in the 2011 survey remained unchanged from 2010, suggesting that crab size would remain

above average in the 2012 fishing season. The NUE of adolescents ≥ 78 mm has increased since 2007 and was well above the series average in 2011, suggesting high recruitment to the fishery in the short-term (Figure 52).

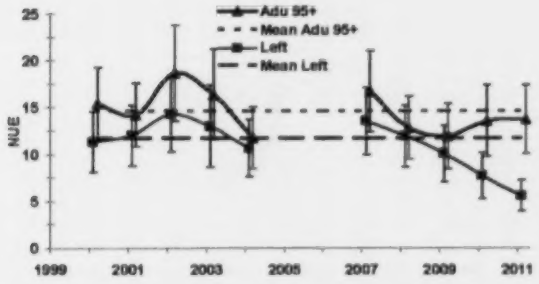


Figure 51. Catch rates (NUE), with confidence interval and mean, of adult crab ≥ 95 mm and those left by the post-season survey fishery in Area 12C from 2000 to 2011 (except for 2005 and 2006).

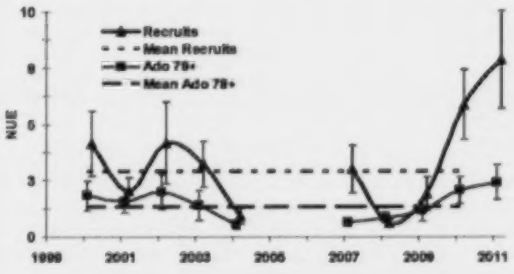


Figure 52. Catch rates (NUE), with confidence interval and mean, of adolescent crab ≥ 78 mm and recruits from the post-season survey in Area 12C from 2000 to 2011 (except 2005 and 2006).

Conclusion and advice

The TAC has been at a plateau of 320 t since 2008 and was met in 2011.

The commercial fishery catch rate has been relatively stable since 2009. In 2011, landings consisted primarily of intermediate-shell crabs.

The post-season survey suggests that 2012 fishing yields will be similar to those of 2011 and landings will include a higher percentage of recruits.

The size of crabs caught in the commercial fishery increased slightly in 2011 compared to 2010 and was above average. According to the post-season survey it should remain at similar levels in 2012.

The post-season survey indicated that the abundance of adolescent crab ≥ 78 mm has been trending upward since 2007 and was above average in 2010 and 2011.

Commercial biomass remained stable and low. The post-season survey suggests increased recruitment as in adjacent areas. The TAC should not be increased until commercial biomass indicators reflect the expected impact of recruitment. Decreasing the TAC would help commercial biomass recover in the shorter term.

Recommendation

Maintaining 2012 catches at 2011 levels should preserve the commercial biomass.

Area 16A

Description of the fishery

Area 16A has a brief fishing history. It includes two banks (north and south sectors) separated by the deep channel of the Jacques-Cartier Strait. Since 2002, it has been accessible to the 43 Quebec fishers holding a snow crab fishing licence in Area 13. The TAC has been at a plateau of 426 t since 2009 (Figure 53) and was met in 2011. The fishery opened April 11 and closed July 17.

Resource status in 2011

The standardized CPUE from the commercial fishery was near the series average from 2002 to 2007 then increased in 2008, before dropping below average from 2009 to 2011 (Figure 54). An increase in fishing effort in the southern section in 2010 and 2011 resulted in a better distribution of fishing pressure between the north and south than in previous years. Since 2008, landings have consisted primarily of intermediate-shell crab (condition 3), even though recruits (conditions 1 and 2) and old crabs (conditions 4 and 5) accounted for a significant percentage in 2010 and 2011 (Figure 55). The mean size of legal-size adult crab caught at sea has decreased since 2008, but remained above the series average, at 109.5 mm for 2011 (Figure 56).

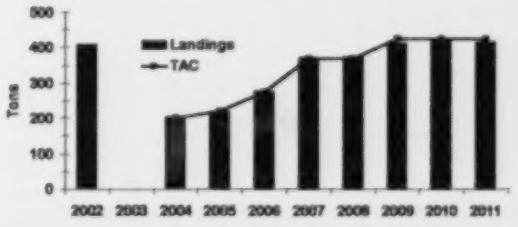


Figure 53. Landings and TAC in Area 16A from 2002 to 2011.

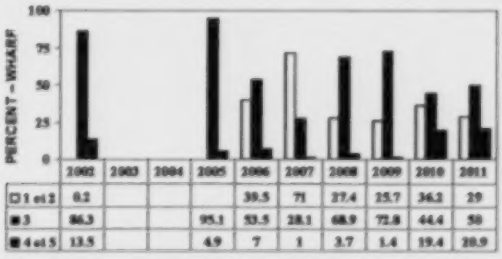


Figure 55. Carapace conditions for commercial crabs landed in Area 16A from 2002 to 2011.

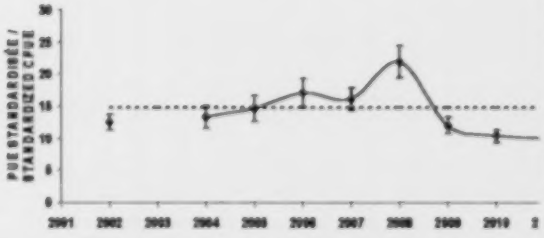


Figure 54. Standardized CPUE ± confidence interval in the commercial fishery from 2002 to 2011 in Area 16A. The dotted line shows the data series mean.

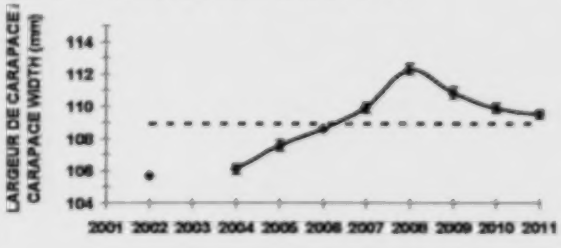


Figure 56. Mean carapace width ± confidence interval for commercial-size crab sampled at sea from 2002 to 2011 in Area 16A. The dotted line shows the data series mean.

The scientific trap surveys, conducted since 2002, show little variation in the NUE of adults ≥ 95 mm since the beginning of the series, except for 2005, when it increased significantly. Between 2010 and 2011, it was stable and very slightly below average. The number of intermediate-shell or old crabs (conditions 3 to 5) has decreased since 2008 (Figure 57). After falling steadily from 2002 to 2008, recruits have increased significantly since 2009 reaching the highest value of the series in 2011 (Figure 58). The post-season trap survey suggests that biomass available at the beginning of the 2012 fishery will be similar to 2011 levels, and landings could consist primarily of recruits. The mean size of legal-size adult crab ≥ 95 mm was greater in 2011 than in 2010, suggesting that the size of crabs landed in the 2012 fishing season will remain high. The NUE of adolescents in traps, which gradually decreased from 2003 to 2007, increased significantly in 2009, suggesting high recruitment in the short-term (Figure 58).

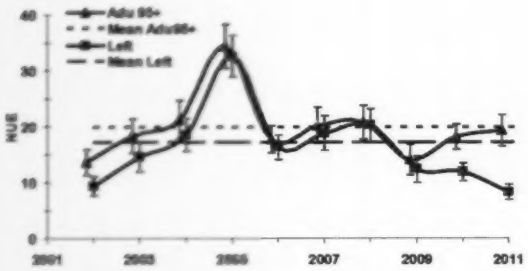


Figure 57. Catch rates (NUE), with confidence interval and mean, of adult crab ≥ 95 mm and those left by the post-season survey fishery in Area 16A from 2002 to 2011.

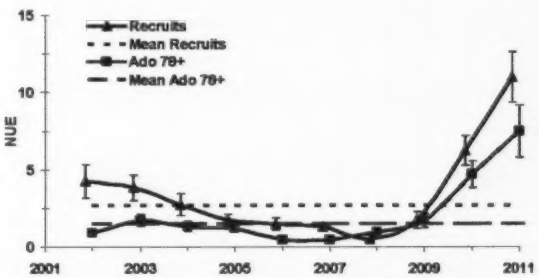


Figure 58. Catch rates (NUE), with confidence interval and mean, of adolescent crab ≥ 78 mm and recruits from the post-season survey in Area 16A from 2002 to 2011.

Conclusion and advice

The TAC and landings have peaked at 426 t since 2009.

The commercial fishery catch rate was low but relatively stable since 2009. In 2011, landings consisted primarily of intermediate-shell crabs.

The post-season survey suggests 2012 fishing yields will be similar to those of 2011 and landings will include a higher percentage of recruits.

The size of crabs caught in the commercial fishery decreased slightly in 2011 compared to 2010 and was slightly above average. According to the postseason survey it could increase in 2012.

The post-season survey indicates that the abundance of adolescent crab ≥ 78 mm has been trending upward since 2008, reaching high values in 2010 and 2011.

Commercial biomass remained stable and low. The post-season survey foreshadowed increased recruitment as in adjacent areas. The TAC should not be increased until commercial biomass indicators reflect the expected impact of recruitment. Decreasing the TAC would help the biomass recover in the shorter term.

Recommendation

Maintaining 2012 catches at 2011 levels should preserve the commercial biomass.

Sources of uncertainty

The quality of science advice depends largely on the accuracy of parameters obtained through sampling and the subsequent analyses. Information obtained from logbooks and purchase slips during the fishing season affects the accuracy of the parameters derived from these documents. For instance, abundance indices and fishing effort calculations obtained from logbooks may include errors that will affect the science advice provided. The selectivity and catchability of traps can vary depending on the type of trap used, its volume and mesh size, the amount and quality of bait used and soak time, which can vary with fishing strategies employed and the prevailing environmental conditions. The catchability of adolescent crabs and recruits can also be affected by the abundance of intermediate-size crabs (condition 3) on the seafloor. The selective sorting of catches can also affect the quality of the data obtained.

The abundance and condition indices and the estimates of crab size obtained from the trawl and trap surveys depend on the type of gear used and are affected by uncertainties related to catchability variations in the different crab groups targeted. Some types of fishing gear are better suited to given seafloor areas than other types and this factor influences the spatial coverage ultimately sampled. The biological characteristics specific to snow crabs can also create sources of uncertainty that impinge on the science advice. For instance, the terminal moulting phase, which occurs at various sizes, will affect crab condition and catchability. Natural mortality can also vary with the life stage and condition of the crabs.

SOURCES OF INFORMATION

This Science Advisory Report is from the February 7-8, 2012 Assessment of the Estuary and northern Gulf of St. Lawrence Snow Crab. Additional publications from this process will be posted as they become available on the Fisheries and Oceans Canada Science Advisory Schedule at www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm.

Dufour, R. and J.-P. Dallaire 2003. Status of snow crab populations in the St. Lawrence Estuary and the Northern Gulf of St. Lawrence from 1999 to 2001. DFO Can. Sci. Advis. Sec., Res. Doc. 2003/048.

DFO. 2011. Assessment of the Estuary and Northern Gulf of St. Lawrence (Areas 13 to 17, 12A, 12B, 12C and 16A) Snow Crab Stocks in 2010. DFO Can. Sci. Advis. Sec., Sci. Advis. Rep. 2011/038.

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ISSN 1919-5079 (Print)
ISSN 1919-5087 (Online)
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address.

CORRECT CITATION FOR THIS PUBLICATION

DFO. 2012. Assessment of the Estuary and Northern Gulf of St. Lawrence (Areas 13 to 17, 12A, 12B, 12C and 16A) Snow Crab Stocks in 2011. DFO Can. Sci. Advis. Sec., Sci. Advis. Rep. 2012/030.